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Abstract

The present study included 4,653 observations from 882 Angus bulls and heifers born during the spring of 1998 to 2001. Each year cattle were scanned four to eight times for ribeye area (UREA) and other ultrasound traits, starting at a minimum age of 27 weeks. The objective of the current study was to estimate variance components, heritability, and repeatability of UREA. Direct additive genetic variance increased from 7.11 to 19.4 cm4 as measurement age increased from 27 to 62 weeks. For the same time period direct permanent environmental variance increased from 14.7 to 26.6 cm^4. When averaged by four weeks intervals, heritability of UREA ranged from 0.29 to 0.39. Mean repeatability values ranged from 0.80 to 0.86. Yearling heritability and repeatability were estimated at 0.39 and 0.80, respectively. For the range of ages considered, the present results showed an optimum heritability and repeatability of UREA measures around 52 weeks through at least 62 weeks of age.

Keywords

ASL R1824, Animal Science

Disciplines

Agriculture | Animal Sciences

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Summary

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Introduction

As the beef industry moves towards value-based marketing system, its viability depends on the ability to produce high-quality consistent end-product. This could be achieved through breeding and feeding programs tailored toward specific consumer demand. Currently, EPDs for compositional traits are computed based on data from bulls and developing heifers measured at 12 and 14 months of age, respectively. To maximize genetic changes in body composition traits, ultrasound data should be collected at the earliest possible time when individual animal phenotypic differences are best indicators of genetic potential. Therefore, a comprehensive study is needed to determine the general trend in genetic parameters estimates for UREA for a wide range of ages and production condition.

The objective of this study was to estimate variance components, heritability, and repeatability of serially measured UREA in Angus cattle.

Materials and Methods

Source of Data

Bulls and heifers in the present study came from the Iowa State University beef cattle breeding project. The project is designed to develop two lines of beef cattle for use as a research base to answer questions that influence genetic improvement of beef cattle. The two selection lines include a Quality line (Q-line) and a Retail line (R-line). Bulls in the Q-line are primarily selected for ultrasound predicted intramuscular fat EPD. Bulls in the R-line are selected primarily for UREA and percentage of retail product (PRP) EPD. In addition, bulls in both lines are required to meet birth weight EPD, fertility, and functional criteria.

The project was initiated in 1997 with the purchase of 285 spring1996-born, purebred registered Angus heifers. Heifers were purchased from two herds in Nebraska and three herds in South Dakota. The heifers were randomly assigned to the two selection lines. Both lines were managed under similar condition at the Rhodes research and demonstration farm located in central Iowa. Each year breeding took place in June and July, with calving the following spring

After weaning, bull calves were fed a 1.3 Mcal NEg /kg diet to allow a mean weight gain of 1.5kg/day. Replacement heifers were fed a 1.1 Mcal NEg/kg diet to allow a mean daily weight gain of 0.70 to 1.1 kg/d

Animals and Scanning Procedure

Serial ultrasound data were collected on progeny over a four-year period between 1998 and 2001. Each year the weaned bull and heifer calves were scanned four to eight times for UREA and other ultrasound traits starting at a minimum age of 27 weeks, with an average interval of 4 to 6 weeks between scans. Bulls and heifers were scanned using an Aloka 500V real-time ultrasound machine, equipped with a 3.5-MHZ, 17.2 cm linear array transducer (Coromertics Medical Systems Inc., Wallingford, CT) or Classic Scanner-200, equipped with a 3.5-MHz, 18-cm transducer (Classic Ultrasound Equipment, Tequesta, FL).

Data Analysis

The present analysis included 4653 observations from 882 bulls and heifers. Ages at scanning were expressed in weeks, resulting in 36 different age groups ranging from 27 to 62 weeks.

Variance components were estimated by an average information REML algorithm using DXMRR (Meyer, 1998). Model included fixed effects of contemporary group (birth year, sex, pen, and scan session), fixed Legendre polynomial of age at measurement (quadratic), random animal genetic and permanent environmental effects, and an error term. Animal effects were fitted as a function of Legendre polynomial of age at measurement (quadratic). Residual variances of 4.38, 6.25, and 8.28 cm^4 were used for age ranges of 27-41, 42-47, and 48-62 weeks, respectively.

Results and Discussion

Eight hundred eighty two animals including 396 bulls and 486 heifers were used. Mean ultrasound ribeye area and number of observations used in the current study are shown in Figure 1. Bulls started at a mean of 45 cm^2 (SD = 5.43) and consistently performed better than heifers across all ages. At a year of age, bulls and heifers averaged 77.6 cm^2 (SD=8.24) and 63.9 cm^2 (SD = 9.5 cm2), respectively.

The general trend in direct additive genetic variance and direct permanent environmental (PE) variance is shown in Figure 2. Direct additive genetic variance increased from 7.11 to 19.4 cm^4 as measurement age increased from 27 to 62 weeks. The corresponding increase in direct PE variance for the same period was from 14.7 to 26.6 cm^4. However, the trend in direct PE variance was more flexible than that of direct additive genetic variance. At a year of age, direct genetic and direct PE variances were estimated at 16 and 17 cm^4, respectively.

Mean heritability (h^2) and repeatability (t) values of UREA are provided in Table 1. Parameters were averaged by a class interval of 4 weeks. At a year of age, h^2 and t were 0.39 and 0.80, respectively. Yearling h^2 estimate was lower than previous reports based on multiple traits analysis, but agrees with h^2 values currently used by the national cattle evaluation program for the Angus Breed. Genetic association between yearling data and measurements made at other ages increased as the difference (distance) between measurement ages decreased (Figure 3).

For the range of ages used in the current study, the results suggest a medium genetic control of UREA measures and that h^2 values are at their optimum level at about a year of age. Therefore, yearling UREA measures are good indicator of genetic potential for the trait in Angus cattle. The strong positive genetic association between yearling and other measures indicates that measurements at different ages are controlled by the same set of genes. Therefore, earlier measures could be used to bring genetic improvement in UREA. However, due to low h^2 of the trait at earlier ages, selection for UREA at these ages may slow the rate of genetic progress.

Implications

Ultrasound ribeye information from yearling bulls and 13 to 14 month old heifers from good quality images can be used to evaluate the genetic potential Angus cattle for UREA.

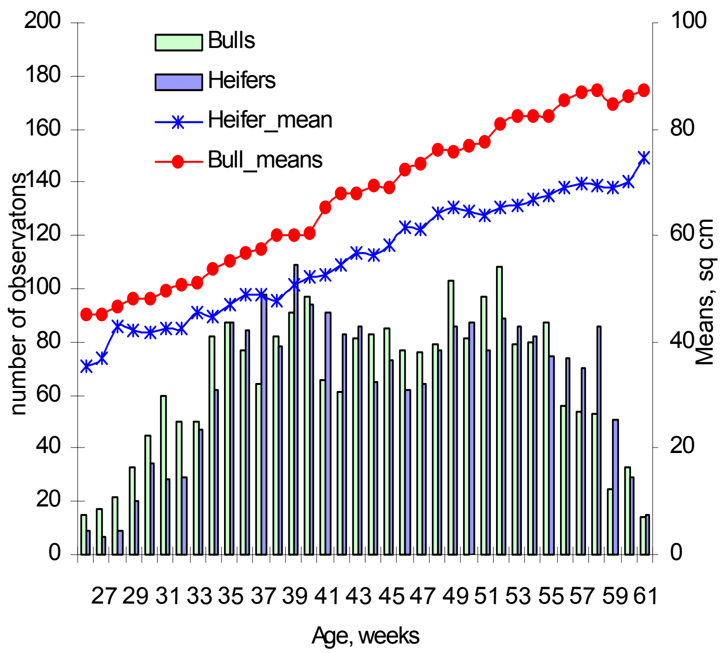

Figure 1. Number of observations and mean UREA of young Angus bulls and heifers.

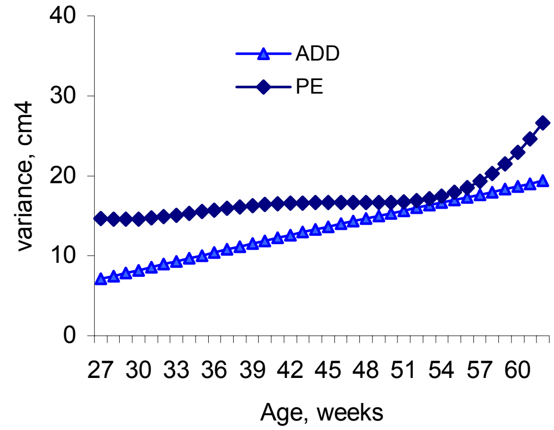

FIgure 2. Trends in direct additive genetic (ADD) and permanent environmental (PE) variance for ribeye area measures in Angus bulls and heifers.

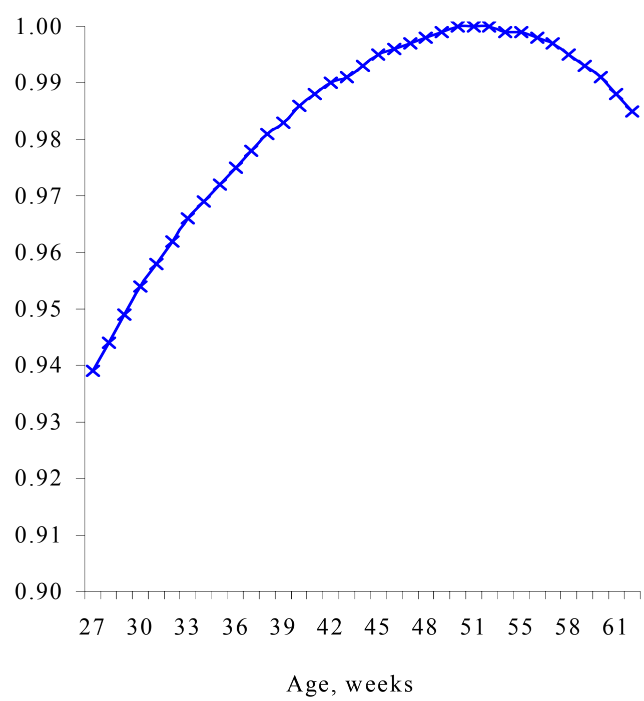

Figure 3. Genetic correlations between yearling UREA and measurements made at other ages.

Table 1. Means and standard errors of heritability and repeatability of UREA measures by age class interval of 4 weeks.

Age interval , weeks	Heritability	Repeatability
27-30	0.29	0.83
31-34	0.32	0.85
35-38	0.34	0.86
39-42	0.36	0.85
43-46	0.37	0.83
47-50	0.38	0.80
51-54	0.39	0.80
55-58	0.39	0.82
59-62	0.37	0.84
Overall SD	0.006	0.003